Microhmmeter
Type DO5000 Series

Operating Instructions

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Limited Warranty & Limitation of Liability

CROPICO guarantees this product for a period of 1 year. The period of warranty will be effective at the day of delivery.

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Disposal of Old Product

This product has been designed and manufactured with high quality materials and components that can be recycled and reused.

When the crossed out wheelie bin symbol is attached to a product it means the product is covered by the European Directive 2002/96/EC.

Please familiarise yourself with the appropriate local separate collection system for electrical and electronic products.

Please dispose of this product according to local regulations. Do not dispose of this product along with normal waste material. The correct disposal of this product will help prevent potential negative consequences for the environment and human health.

User Note:
These Operating Instructions are intended for the use of Competent Personnel.

English Important Safety Information 10/08/99

General
This instrument has been designed and tested to comply with the Electromagnetic Compatibility Directive 89/336/EEC and Low Voltage Directive 93/68EEC in accordance with EN 61010 -1 :1995 relating to the safety requirements for electrical equipment for measurement, control and laboratory use. Before connecting the instrument to the mains supply please ensure the following safety precautions have been read and understood.

Safety Symbols
The following symbols are used to describe important safety aspects of this instrument, these symbols appear on the instrument and in the operation instructions.

Attention Symbol: Indicates a potentially hazardous condition exists and that it is necessary for the operator to refer to the instruction manual to ensure the safe operation of this instrument.

Hot Surface Warning: Indicates a hot surface that may be at a temperature capable of causing burns, refer to the instruction manual for further safety information.

Caution Risk of Electric Shock: Indicates hazardous voltages may be present, refer to the instruction manual for further safety information.

Protective Conductor Terminal: For protection against electrical shock during a fault condition. This symbol is used to indicate terminals that must be connected to electrical ground before operating equipment.

Summary of Safety Precautions
The following general safety precautions must be observed while operating or servicing this instrument. Failure to comply with these precautions may result in personnel injury or death.

Instrument Electrical Earth
This instrument is designed as a Class 1 electrical safety insulation device. To ensure continued protection from electric shock the instrument chassis must be connected to an electrical ground. The instrument is supplied with an AC power cable with an earth connection.

Live Circuits Danger
Do not connect the power supply to or operate this instrument with the protective covers removed. Component replacement and internal adjustments must be made by qualified service personnel. Do not replace components with the power cable connected. Under certain conditions, dangerous voltages may exist with the power cable removed. To avoid injuries always disconnect power and discharge circuits before touching them.

Do Not Modify this Instrument or Substitute Parts
Because of the danger of introducing additional hazards; do not perform any unauthorised modification or install substitute parts to the instrument. Only fuses with the rated current, voltage and specified type should be used, failure to do so may cause an electric shock or fire hazard. Return the instrument to Automatic Systems Laboratories for service and repair to ensure the safety features are maintained.

Do Not Operate in either Damp or Explosive Environments
This instrument is not designed to operate while wet, in an environment of condensing humidity or in the presence of flammable gases or vapours. The operation of this instrument in such an environment constitutes a safety hazard.

Certification
CROPICO certifies that this product met its published specifications at the time of shipment from our factory. All calibration measurements performed in the manufacture of this instrument are traceable to the National Physical Laboratory (London).

Assistance
For after sales support and product service assistance please contact CROPICO Customer Support Group. Contact information is provided in the operation instruction manual.

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1. Introduction

1.1 Overview

The DO5000 Microhmmeter is a high accuracy instrument designed for industrial and laboratory resistance measurements.

Features include:

- Programmable measuring current user selectable in 100 steps.
- Automatic temperature Compensation.
- Hi/Lo Limits with red/green front panel warning Pass/Fail lamps.
- Switched current mode with automatic averaging ensures elimination of thermal emf errors.
- Large graphic LCD display for resistance measurement values as well as configuration settings and statistical results.
- Advanced functions include data logging and statistical reporting with max/min, average values peak to peak values and standard deviation.
- Analogue output, IEEE-488 and RS232 communication, and PLC interfaces available for automated monitoring and controlling applications.
- Fast mode 50 measurements/second for production testing.

The DO5000 is a true four wire measuring instrument eliminating the need to compensate for lead resistance. The measured value is displayed in large characters with decimal point and units kΩ, Ω, or mΩ. For maximum accuracy the measuring current may be automatically reversed and the average of measurement displayed. For measurements on unstable samples, a rolling average filter is available.

Resistance measurement accuracy is typically 0.03% (1 year specification) and the value may be displayed with or without temperature compensation, the final accuracy depends upon the current selected.

The front panel measurement connections are made via 4mm sockets located on the front panel. The connection to a Pt100 temperature sensor is made with a standard DIN connector.

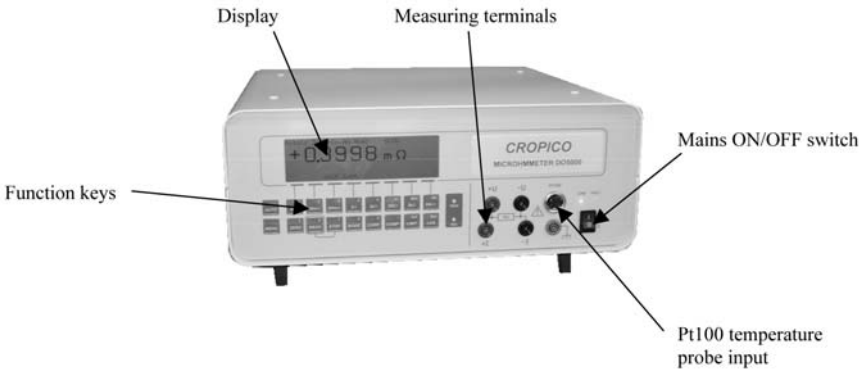
1.2 Definitions and Terminology

μΩmicrohmm	0.000001 Ohm
mΩmilliohm	0.001 Ohm
kΩkilohm	1000 Ohm
Pt100	Platinum resistance thermometer (100Ω at 0°C)
+U/-U	Voltage connection
+I/-I	Current connection
Four terminal measurement	Kelvin principle of measurement using 2 wires (I1 I2) to pass current through Rx and 2 wires (P1 P2) to measure the voltage.
Kelvin clips	Crocodile clips with isolated jaws, one side being the current I connection, the other voltage U connection.
	Indicates reading compensated for 20°C
Ω/Km	Indicates resistance per Kilometre
Km	Indicates cable length in Kilometres
m	Indicates cable length in metres

1.3 Standard features of the DO5000 Microhmmeter include:

- Direct display of resistance
- Illuminated display
- Up to 10 Amps measuring current (programmable 10% to 100%)
- Automatic Temperature compensation
- Display hold function
- Display zero function
- 4000 event data logger
- Statistical reporting
- Measuring current reversal with auto average
- Hi/Lo Limits with Red/Green front panel warning LEDs
- Fast measuring mode 50 measurements / second
- **General warning symbol.** This indicates that a hazardous condition may exist.

⚠ **You must read the relevant sections in this Operator's Manual before operating the instrument.**



1.4 Principles of measurement

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1.5 Specification

1.5.1 Measurement Accuracy

5000/5001

Range	Max. Current	Resolution	Accuracy at full rated current	Temp. Coefficient/°C
30 kΩ	100μA	1Ω	±(0.03%Rdg+0.02%FS)	10ppm Rdg + 6ppm FS
3 kΩ	1mA	100mΩ	±(0.03%Rdg+0.01%FS)	10ppm Rdg + 6ppm FS
300Ω	10mA	10mΩ	±(0.03%Rdg+0.01%FS)	10ppm Rdg + 6ppm FS
30Ω	100mA	1mΩ	±(0.03%Rdg+0.01%FS)	10ppm Rdg + 6ppm FS
3Ω	1A	100μΩ	±(0.03%Rdg+0.01%FS)	10ppm Rdg + 6ppm FS
200mΩ	10A	10μΩ	±(0.03%Rdg+0.01%FS)	20ppm Rdg + 6ppm FS
30mΩ	10A	1μΩ	±(0.03%Rdg+0.01%FS)	30ppm Rdg + 6ppm FS
3mΩ	10A	100nΩ	±(0.03%Rdg+0.02%FS)	30ppm Rdg + 6ppm FS

5002

Range	Max. Current	Resolution	Accuracy at full rated current	Temp. Coefficient/°C
30 kΩ	100μA	1Ω	±(0.03%Rdg+0.02%FS)	10ppm Rdg + 6ppm FS
3 kΩ	1mA	100mΩ	±(0.03%Rdg+0.01%FS)	10ppm Rdg + 6ppm FS
300Ω	10mA	10mΩ	±(0.03%Rdg+0.01%FS)	10ppm Rdg + 6ppm FS
30Ω	100mA	1mΩ	±(0.03%Rdg+0.01%FS)	10ppm Rdg + 6ppm FS
3Ω	100mA	100μΩ	±(0.03%Rdg+0.01%FS)	10ppm Rdg + 6ppm FS
200mΩ	100mA	10μΩ	±(0.03%Rdg+0.01%FS)	20ppm Rdg + 6ppm FS

The accuracy is quoted at full rated current with auto average current mode and the display count is 30,000* plus sign and unit
The 200mΩ range has a scale length of 20,000

1.5.2 Programmable current

The measurement current is adjustable on each resistance range as follows:

Range	Max Current	Min Current	Steps
30 kΩ	100μA	10μA	1μA
3 kΩ	1mA	100μA	10μA
300Ω	10mA	1mA	100μA
30Ω	100mA	10mA	1mA
3Ω	1A	100mA	10mA
200mΩ	10A	1A	100mA
30mΩ	10A	1A	100mA
3mΩ	10A	1A	100mA

The accuracy of current is typically ±0.25%

1.5.3 Accuracy against current level

Range	100% Current	50% Current	10% Current
30 kΩ	±(0.03%Rdg+0.02%FS)	±(0.04%Rdg+0.02%FS)	±(0.06%Rdg+0.02%FS)
3 kΩ	±(0.03%Rdg+0.01%FS)	±(0.04%Rdg+0.01%FS)	±(0.05%Rdg+0.01%FS)
300Ω	±(0.03%Rdg+0.01%FS)	±(0.04%Rdg+0.01%FS)	±(0.05%Rdg+0.01%FS)
30Ω	±(0.03%Rdg+0.01%FS)	±(0.04%Rdg+0.01%FS)	±(0.05%Rdg+0.01%FS)
3Ω	±(0.03%Rdg+0.01%FS)	±(0.04%Rdg+0.01%FS)	±(0.06%Rdg+0.01%FS)
200mΩ	±(0.03%Rdg+0.01%FS)	±(0.04%Rdg+0.01%FS)	±(0.06%Rdg+0.01%FS)
30mΩ	±(0.03%Rdg+0.01%FS)	±(0.04%Rdg+0.01%FS)	±(0.06%Rdg+0.01%FS)
3mΩ	±(0.03%Rdg+0.02%FS)	±(0.04%Rdg+0.02%FS)	±(0.06%Rdg+0.02%FS)

1.5.4 Temperature compensation

The accuracy of the temperature measurement is ±0.1% and uses a standard Pt100 sensor. This accuracy does not include errors due to the sensor itself. The temperature measurement range is 0…+40°C and the resistance measurement is referenced to 20°C when this option is used.

1.5.5 Conditions of use

The instrument must be used inside, in a horizontal position
Temperature
Storage: -10°C…+60°C
Operation: 0°C…+45°C
Full accuracy is achieved after 10 minutes warm-up and for a relative humidity <50%
Altitude: up to 2000 metres
Maximum humidity rate: 80% for a temperature of 31°C

1.5.6 Lead resistance

A maximum lead resistance which may be calculated as 0.5Ω/measuring current is permissible in each of the four measuring leads. The display will indicate if the current lead resistance is too high.

"***** MEASURENT ERROR Current lead resistance too high *****"

1.5.7 Mains supply

Universal power inlet: Maximum Power consumption 250VA 45/65Hz

Nominal Voltage	Voltage Range	Frequency	Fuse Type
115 V	103…127 V	47…63 Hz	6.3A (T)
230 V	207…253 V	47…63 Hz	3.15A (T)

1.5.8 Battery Operation DO5001

Two rechargeable sealed lead acid batteries are fitted internally together with the battery charging circuits. The chargers will maintain the batteries in good condition automatically adjusting the charge rate to suit the battery state. Full measurement capability is maintained whilst batteries are charging.

Battery Capacity
Digital: 11 hours continued use with display backlight on
Analogue: Over 6000 simple measurements in fast mode with 10A measuring current.
Approx. 3000 measurements slow mode.

1.5.9 Weight and Size
Size: 147 x 357 x 345 mm (H W D)
Weight: 9.8 kg (DO5000)
12.2 kg (DO5001)
8.15 kg (DO5002)

2 Setting up the DO5000

2.1 Safety information

Please read and follow these important safety instructions:

- Read the safety information at the beginning of this manual before operating the DO5000;
- Make the necessary electrical safety connection checks. In particular, select the correct line voltage and make sure that the correct fuse is installed. Incorrect voltage or fuse selections present both an electrical safety and a fire hazard. Ensure that the rear panel fan is operating and that the vent is not blocked.
- When connecting to an electrical supply mains supply, the mains cord provided with the equipment should be used, and connected only to a mains supply with a suitable earth connection. Under no circumstance should the equipment be operated with earth disconnected.

2.1.1 Mains voltage selection and Changing the fuse

The mains inlet socket is located on the rear panel, to select the correct mains voltage and to replace the fuse proceed as follows.

- Front panel ON/OFF switch in the OFF position
- Remove the power cord from the inlet socket
- With a small screwdriver, remove the selection sub assembly from the inlet module
- Remove the fuse
- Take off the pale grey plastic piece
- Select voltage: 115 for a 115 volts main and 230 for a 230 volt main
- Replace the grey plastic piece to display the correct voltage in the sub assembly window
- Replace the correct value fuse according to the table 1.5.7
- Replace the selection sub-assembly in the inlet module
- Connect the power cord

2.2 Unpacking the instrument

When you unpack the DO5000, check that the following items are present before starting to use the unit:

- 1 x DO5000 Microhmmeter
- 1 x Mains Cord
- 1 x Operating Manual
- 1 x Calibration Certificate
- 1 x LS05-P Lead Sets Certificate

Please contact the CROPICO Customer Support Team immediately if any of these items are missing or damaged.

Please note that we offer a wide selection of measuring leads and test fixtures, see section 6, please consult our sales staff to order the items most suited to your application.

3 About the DO5000

This section introduces you to the features and functions of the DO5000 Microhmmeter.

3.1 The Front Panel

3.2 ON/OFF Switch

The On/Off switch switches the DO5000 on and off. During Power On the last measurement function setup is restored. The rear mounted cooling fan will always run and the cooling vent must not be blocked.

3.2.1 ON/OFF Switch Battery Version DO5001

The Front Panel on/off switches the DO5001 on and off. The rear switch situated adjacent to the inlet filter switches the mains supply on/off.

3.3 The Function Keypad

All DO5000 measurements and programming facilities are accessed through the function keypad. A brief description of key functions is given in the following table. For a detailed description of how to use the keys to configure and operate the DO5000, refer to section 4.

3.4 Table Summary of basic functions

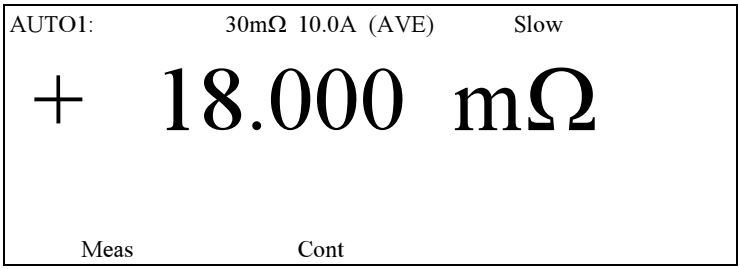
Key Symbol	Description	Function	Direct function or menu
Selection	**of Range**		
3mΩ	Selects 3mΩ range	Selects and displays the measured value using the 3mΩ range	Direct from keypad
30mΩ	Selects 30mΩ range	Selects and displays the measured value using the 30mΩ range	Direct from keypad
200mΩ	Selects 200mΩ range	Selects and displays the measured value using the 200mΩ range	Direct from keypad
3Ω	Selects 3Ω range	Selects and displays the measured value using the 3Ω range	Direct from keypad
30Ω	Selects 30Ω range	Selects and displays the measured value using the 30Ω range	Direct from keypad
300Ω	Selects 300Ω range	Selects and displays the measured value using the 300Ω range	Direct from keypad
3kΩ	Selects 3kΩ range	Selects and displays the measured value using the 3kΩ range	Direct from keypad
30kΩ	Selects 30kΩ range	Selects and displays the measured value using the 30kΩ range	Direct from keypad
Auto	selects autorange	The instrument will select the optimum range required and display the measured value	Direct from keypad

Setting	up measurement	options	
CURR	Current selection	Selects the current to be used for measurement plus single polarity or switched average	Menu
Mode			
COMP	Temperature compensation	Selects temperature compensation	Menu
ZERO	Measurement display zero function	Nulls the display at the current reading and displays measured values relative to the nulled value	Direct from keypad
MES	Measure run/hold	Display hold function triggers measurement and data logger cycles.	Direct from keypad
STOP	Measure stop/start	Stops the current measurement and disconnects the measurement current	Direct from keypad
Logging	**Data and**	**Statistical Displays**	
LOG	Data logging function	Selects the data logging and statistical analysis menu functions	Menu
Options	**and Configuration**		
LIMIT	Limit functions	Selects Hi/Lo limit menu	Menu
MENU	Menu functions	Selects interface options and calibration functions	Menu
Scroll	**and Contrast**	**Control**	
MENU	Up command key; Display contrast, page scroll	Controls the display contrast and page scroll functions	Menu
MENU	Down command key; Display contrast, page scroll	Controls the display contrast and page scroll functions	Menu

3.5 About the DO5000 Display screen

The liquid crystal graphic display clearly indicates the measured resistance and measurement status as well as displaying available menu options and measurement analysis when selected.

Figure 3.5.1 - Example of Resistance Measurement Mode



The keypad below the display screen controls the DO5000.

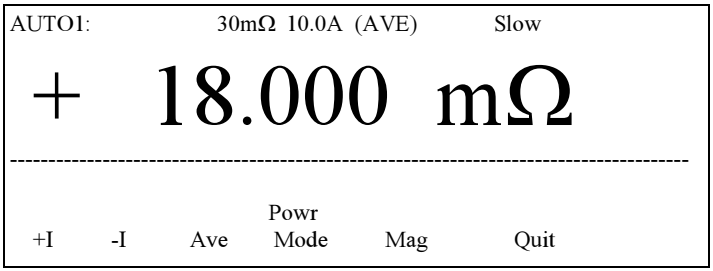
Some keys perform a function directly. For example,

selects 3mΩ range.

Other keys switch the display to configuration mode which allows you to select options through a series of menus.

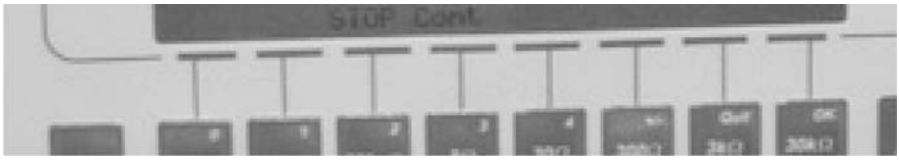
The option menus all follow the same format. The configuration mode is indicated by splitting the screen with a dashed line directly below the main reading. An instruction prompt under the dashed line indicates the current menu. The available menu options are displayed on the bottom row of the display as shown in figure 3.5.2. Press the corresponding function key to select an option.

Figure 3.5.2 Example of current mode menu



Indicates current mode Indicates menu options.

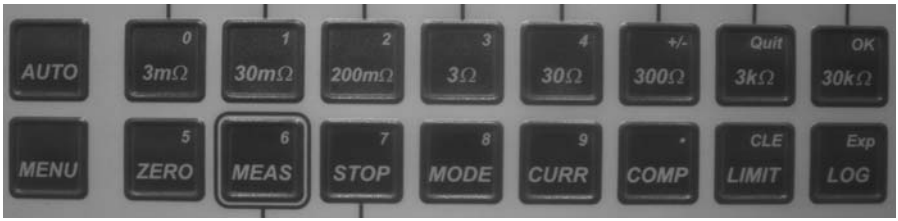
The lines printed on the front panel helps you to link the menu option printed on the screen with the correct key on the keypad.



3.6 About the Function keys

The top row of function keys are only used to select menu options. The lower row of function keys is enabled only when entering values; these instances are covered later in this section. Both rows of function keys are shown in figure 3.6.1

Figure 3.6.1 - Function keys



The **[Quit]** and **[OK]** menu options consistently use the **[Quit]** and **[OK]** keys. Use the **[Quit]** key to leave a menu or return to the Resistance Measurement mode screen. Use the **[OK]** key to confirm a particular choice and continue to the next set of menu options.

Not all function keys are used to access the Configuration Mode. Some just invoke the function which is printed on the key. For example pressing **[ZERO]** immediately sets the measured value displayed to zero.

The rest of this section describes each key in detail and gives examples of how to configure the measurement to your requirements.

The last used set up conditions are stored when the instrument is turned off and restored upon switch on.

4 Setting up Measurement Options

Note: It is possible to reset the instrument to the original default start up conditions. From the **[MENU]** mode press **[RESET]** to restore defaults.

4.1 Range Selection

Two modes of range selection are possible, Manual and Auto range. The 8 ranges may be selected individually by pressing the appropriate range key. The range selected is indicated on the top left hand side of the display. Auto range is selected using **[AUTO]** key. This key toggles the selected function as follows; AUTO1 auto ranges starting with the highest range. AUTO2 auto ranges starting with the current range selected; Range manual range is selected.

4.2 Current Selection

Press **[CURR**] selects the current configuration menu;

+I	-I	Ave	Mag	Quit

Select the current direction +I -I or Ave ; Ave automatically switches the current in the positive and negative directions and displays the average, this eliminates errors due to thermal emf.

Select the current Magnitude **[Mag]**. Press [**Chng]** and you will be asked to enter the maximum current as a percentage 10…100.

Enter the percentage required using the keys which are numbered in the top right hand corner, press **[OK]** to confirm. The current value for the range selected is displayed at the top center of the screen. **The percentage of maximum current set will be applied to all subsequent measurement ranges selected.**

4.3 Measurement Mode

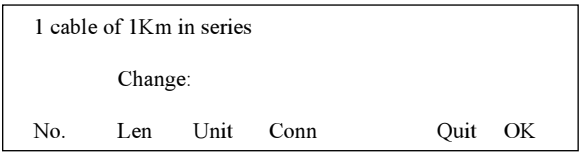
Press **[MODE]** to select the measurement mode options

	Display		Trig	Read			
Ω	Ω/Km	Km	Mode	Rate	Filt	Sett	Quit

For the greatest flexibility and versatility of measurement the DO5000 has many advanced features which can be selected from this menu.

Display

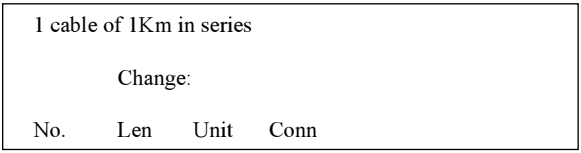
The main value display can be set to read Ω, Ω/\km or Km. From the measurement **[MODE]** screen select [Ω/Km] this display will read:



Select **[No.]** Display will ask you to enter the number of conductors 1 – 99, enter the number and press **[OK]**. Select **[Len]** the display will prompt you to enter the cable length **[enter value (Km)]**. To select the units to be displayed select **[Unit]** metre or Km can be selected. Finally, select **[Conn]** and the option to select whether the conductors are in series **[Ser]** or parallel **[Par]** is available. Press **[OK]** to confirm.

Once these parameters are set the measured value will display in Ω/Km for any number of conductors 1 – 99 in series or parallel.

To display the cable length in Km select **[MODE]**, **[Km]**, the display reads:



To change the number of conductors select **[No.]** the display will ask you to enter the number 1 – 99. Enter the number and press **[OK]**. Select **[Res]** and you will be prompted to enter the resistance of the cable in ohm/Km, enter the value and press **[OK]**. To change the units press [Unit] you can now select **[Km]** or **[m]**. Press **[OK]** to confirm selection. To change the connection configuration select **[Conn]** and the option to select the conductors in series or parallel, again press **[OK]** to confirm. Once the configuration is complete, press **[Quit]** to return to the measurement screen which will display the measured cable length in Km or m.

Press **[Trig Mode]**. To select continuous measurement press **(Cont)** or **(Sing)** to select a single measurement, this completes one measurement and holds the value on the display. To trigger a new measurement the direct function key **[MEAS]** should be pressed.

Press **[Read Rate]** to select (Fast) or (Slow) measurement mode. With Fast mode selected the DO5000 will measure at 50 measurements per second. This mode is intended for automatic measurements using one of the interfaces to output the measured values or control an external process. The measured value will be displayed in small text on the screen when Fast measurement mode is used.

For manual operation the Slow measurement mode should be selected. This will read at 2 measurements per second and offer the highest accuracy and resolution.

Press **[Filt]** to select the digital filter, this feature should be used when the sample to be measured is unstable and the measured value displayed is constantly changing. The filter is a rolling average of n measurements where n may be set between 1 and 32.

Press **[Sett]** to select the setting time filter; this would normally be used when measuring inductive samples such as motor winding resistance.

Press **[Limit]** to set maximum number of permissible digits 1-999 that the reading can change.

Press **[No of readings]** to select the number of readings 2-999 that the set limit must conform to.

4.4 Temperature Compensation

Press **[Mode]** to select the setup menu for temperature compensation
Press **[Ext]** to select the external temperature sensor.
Press **[Man]** to select the manual compensation temperature, the display will request that you enter the ambient reference temperature.
Press **[Cu]** to select compensation for copper 3930 ppm/°C
Press **[Al]** to select compensation for Aluminum 4100 ppm/°C
Press **[Usr]** to enter alternative user coefficients

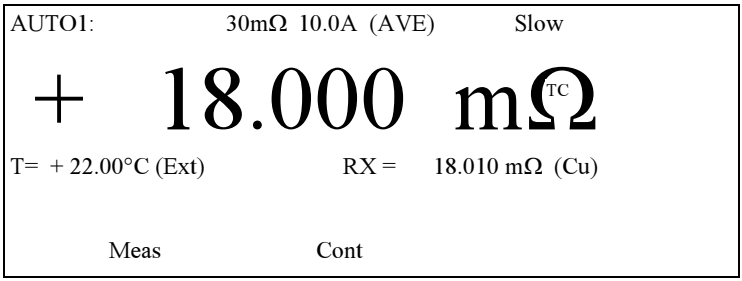
The equation used to calculate the corrected resistance is:

Rc (20°C) = Rx/1+ (tx - 20°C)
where Rc = resistance corrected for a reference temperature 20°C
} = Average temperature coefficient
tx = Component temperature at time of the measurement

The temperature compensation mode should be used when measurements are required to be referenced to 20°C. This is particularly useful when measuring materials with a high temperature coefficient such as copper, as the ambient temperature varies so will the resistance value being measured. Using the temperature compensation mode references all values back to a temperature of 20°C.

The compensated resistance value measured will be displayed in large digits in the centre of the display and the true resistance will be displayed in smaller text below. The ohms sign of the compensated value will show a 20 in the centre to indicate that the value is referenced to 20°C.

Figure 4.4.1 Measurement screen with temperature compensation



4.5 Limits

Press **[Lim]** To select the Limits menu.

Two options are then available **[Meas]** which enables limits to be set with reference to the measured values or **[O/C]** which enables the open circuit voltage to be limited to either 20mV or 50 mV. Note: Open circuit limits are not available on 3K x 30K ranges.

Select **[Meas]** to select the measurement limits menu.

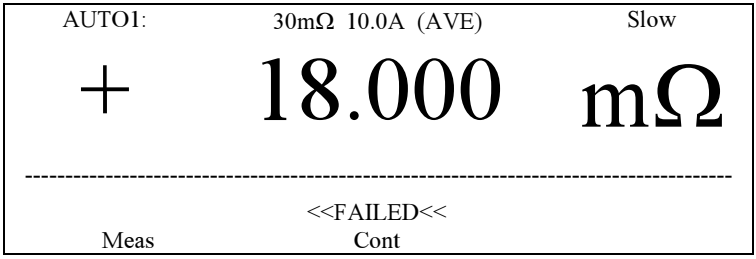
Select **[Alm]** to turn the audio alarm **(Beeper)** on or off.

Select **[Max]** to set the max or upper limit value press **[Chg]** and the screen will prompt you to select the units mΩ…Ω…kΩ. Select the required units and the display will ask for a new max limit value to be entered. Use the numbered keypad to enter the required limit, press **[OK]** to confirm.

Select **[Min]** to set Min or lower limit value, proceed as for setting max limit.

The Green Pass front panel LED will light when the measured value is correct and within the set limits, the Red Fail LED will light and the warning beeper will sound if the measured value is higher than the Max limit set or lower than the Min limit set. The DO5000 screen will also display PASS or FAILED with >> to show value to high and << to show value to low.

Figure 4.5.1 Measurement screen with limits



To select the open circuit voltage limit from the **[Lim]** menu select **[O/C]** the option of selecting either 20mV of 50mV limit is then available. The measurement display will indicate in the top right hand corner which limit has been set.

4.6 Data Logging Function

Press **[LOG]** to select the data logging menu
Select **[New]** to initiate a new log the screen will prompt you to clear the current log. Press **[Yes]** the screen will ask you confirm, press yes again and the current log will be cleared of all stored values. You are now ready to set up the new log.

Press **[No. Rdgs]** the current number of readings is displayed to accept that value press **[Yes]** to store a different number press **[No]** you will then be asked to enter the value of the number of readings to be stored in the log. Enter the number required between 1 and 4000 and press **[OK]**. Press **[Rev]** to review the current readings stored in the log these will be displayed in table form as shown in Figure 4.6.1

Figure 4.6.1 Data Logging Screen

Log #	Range	Resistance	Date	Time
1	30kΩ	0.000	10/08/99	14:10:35
2	30kΩ	0.000	10/08/99	14:10:37
3	30kΩ	0.000	10/08/99	14:10:38
4	30kΩ	0.000	10/08/99	14:10:40
5	30kΩ	0.000	10/08/99	14:10:42
6	30kΩ	0.000	10/08/99	14:10:44

Once the logging mode has been switched ON the measurement display will be in HOLD mode and the bottom line of information text will show the total number of samples to be stored and the number of measurements already stored. (Samples = 40/40). To start the logging press the **[MES]** key the measurements will start and the values stored. Once the set number of values has been stored in the log the measurements will be stopped.

Press **[Stats]** to display the statistical analysis of the values stored in the log. The following values will be computed and displayed.
Minimum value [Min] Maximum value [Max]
Mean value [Mean] Peak to Peak value [PtP]
Standard Deviation [SD]

4.7 Setup Memory

To enable up to 10 measurement configurations to be setup and stored the DO5000 has 10 memories to store and recall these configurations;-
Press **[MENU]**
Press **[Mem]** to select memory menu
Press **[STOR]** to store the current measurement setup you will be prompted to enter a memory store number 0 to 9, selecting the store number saves the current setup to that store number
Press **[RCL]** to recall a previously stored setup you will be prompted to enter the memory store number that you wish to recall, entering that store number recalls the stored configuration for immediate use.
Press **[List]** to display a list of memories in current use
Press **[CLR]** to clear a previously stored configuration you will be prompted to enter the store number , entering the number will erase the stored parameters from that memory.

The following parameters will be stored when saved to memory:-

PARAMETER	DEFAULT VALUE
Range	30kOhm range
Auto-range	on - auto 1
Current direction	positive
Current Magnitude	100%
Current mode	DC
Trigger mode	continuous
Reading rate	slow
Temperature compensation	off
Temperature compensation mode	manual
Temperature compensation material	copper
Manual compensation temperature	20∞C
Filter	off
Filter - No of readings	10
Measurement limits	off
Measurement limits alarm	on
Measurement limit - maximum	30 kOhm
Measurement limit - minimum	0
Open circuit limit	off
Log mode	off
Log mode - No. of readings stored	10

4.8 Display Menu

Press **[MENU]** to select the display menu
Press **[RESET]** to reset measurement configuration to default values.
Press **[MEM]** to select memory menu
Press **[LCD]** to select LCD display menu, Press [ ] to turn backlight ON or OFF, Press and hold [[]] to lighten then display contrast, Press and hold [®] to darken the display contrast.

Press **[Set Up]** to select the configuration menu. **[Beep]** turns the beeper on and off, **[Time Date]** enables the current time and date to be set, **[Lang]** enables the display to be toggled between English and French language, **[Temp Unit]** permits the temperature units to be switched between ˚C and ˚F, **[Line Freq]** allows the measurements to be synchronized at 50Hz or 60Hz and should be set in accordance with mains supply frequency used, this is particularly important when measuring in fast mode. Press **[Ver]** to display the model number and software version.

Press **[Rem I/F]** to select the remote interface option menu

Press **[Key Lock]** to select the option of locking the keyboard to ensure no parameters are changed without authorisation. You will be asked to enter a pass code before you can enter this menu. The default pass code is 9252 and this can be changed once you have entered the Key Lock menu. Three options are available **[ALL]** enables all keys and permits normal control of the DO5000. **[MEM]** permits operation of the Memory, Recall, and Measure Keys only. **[Measure]** restricts operation to the Measure Key only. Once the Key Lock facility is enabled the measurement screen will display a small padlock symbol in the bottom right hand corner.

4.9 Measure/Hold function

Press **[Mes]** to hold the measured value on the display. **NOTE** this does not interrupt the measuring current which will still be flowing through the resistance being measured. **WARNING** when measuring with 10 Amps measuring current, it is possible to produce small sparks at the current terminals. Press **[Mes]** to resume display of measured values.

4.10 Measure Stop Function

Press **[STOP]** to stop the measurement this disconnects the current from the terminals and internally shorts the current terminals discharging any voltage that may be stored in capacitive samples.

4.11 ZERO Function

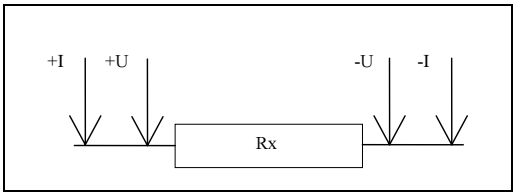
Press **[ZERO]** to null the current display reading to zero, all subsequent measurements will be relative to the nulled value. Pressing **[ZERO]** again cancels the zero. Changing range or selecting auto range also cancels the zero.

5 Measuring with the DO5000

5.1 Connecting to the DO5000

The DO5000 uses a four terminal method of measurement which eliminates errors due to lead resistance. The measuring leads plug into the four front panel safety sockets. The sockets are marked +U, -U, +I, & -I. Connections to the resistance to be measured should be as per Figure 5.1.1

Figure 5.1.1 Connection diagram



NOTE: It is important to connect the I (current) leads outside the U (potential) leads

5.2 Connecting to the resistance

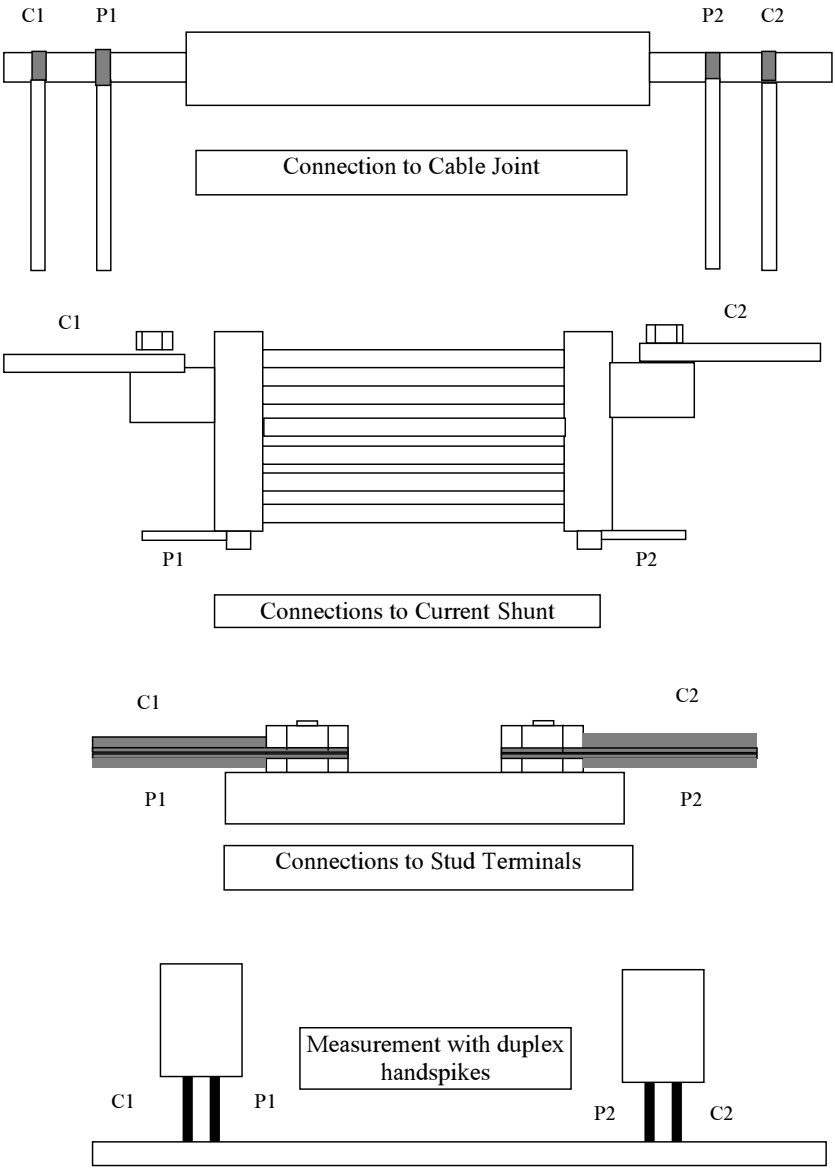
The Digital Microhmmeter DO5000 employs a four wire method of measurement, i.e. it is necessary to make four connections to the resistance under test. The instrument is supplied with four leads; two for the potential connections which are made across the test resistor at the points between which the resistance is to be determined; and two for the current connections which connect the test resistor to the current supply circuit.

5.2.1 Connect the red leads to the +U and +I sockets and the black leads to the -U and -I sockets.

5.2.2 Connect to the resistance under test as shown in figure 5.1.1, Cleanliness is important and if the sample is not clean, a rub with an abrasive paper to remove oxides is recommended.

5.3 It is not always possible to use the combined current and potential crocodile clips (Kelvin clips), in which case test leads with spade tags, or special fixtures may have to be made to suit the particular application. We offer a variety of different lead and fixture types which are list in section 6.1

Figure 5.3.1 Diagram of different connection configurations



5.4 Resistance measurement

The DO5000 should be in the measurement **[STOP]** mode. In this mode the measuring current is switched off and the current terminals are shorted internally. Connect the measuring leads as described in section 5.3 before starting the measurement select the current level and mode required as described in section 4.2 **WARNING the maximum measuring current is 10 Amps on the lowest 3 measuring ranges** ensure that the current level selected will not damage the resistance being measured. Select the range required see 4.1 or auto range.

To start the measurement press the **[MEAS]** button the measured resistance value will be displayed on the screen.

5.5 Resistance measurement with temperature compensation

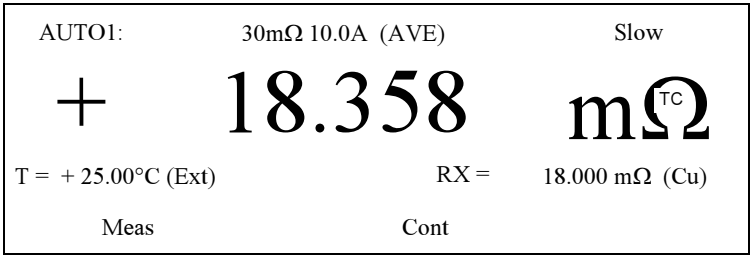
Temperature compensation should be used when measuring the resistance of materials which have a high temperature coefficient. Copper, for example, has a temperature coefficient of 0.3980%/K. The value of the resistance measured will therefore vary with the temperature of the copper. To obtain consistent and meaningful results, the resistance values may be related to a set ambient temperature, normally 20°C.

Example: Copper with a temperature coefficient of 3980ppm/k = 0.3980%/k

Temperature	20°C	25°C	30°C	35°C
Resistance of Copper	18.000 mΩ	18.358 mΩ	18.716 mΩ	19.075 mΩ
% Increase in resistance	0%	1.99%	3.98%	5.97%

To measure with the temperature compensation, proceed as in 4.4 but in addition connect the temperature sensor probe (see section 6 for accessories details and part numbers) to the front panel socket. Select the temperature compensation measurement mode as described in 4.4. Alternatively, if the ambient temperature is stable, a manual value may be entered, in this case a temperature sensor is not required. The true measured resistance value will be displayed in large digits on the DO5000 screen and the compensated value will be shown in smaller digits below the main display. The measured or set temperature will also be shown.

Figure 5.5.1 Display screen temperature compensation mode



5.6 Measurement with Limits

The measurement limits function permits the fast easy sorting of components.To select the limits function see section 4.5. Both high and low limit values may be set.If the measured value is within the set limit boundaries then front panel green PASS LED will illuminate. If the measured value falls outside the set limits then the red FAIL LED will light, a warning beeper will also sound and the instrument display will show FAILED with chevron arrows pointing to the left for value to low and to the right for value to high.

Figure 5.6.1 Measurement display with limits value to low

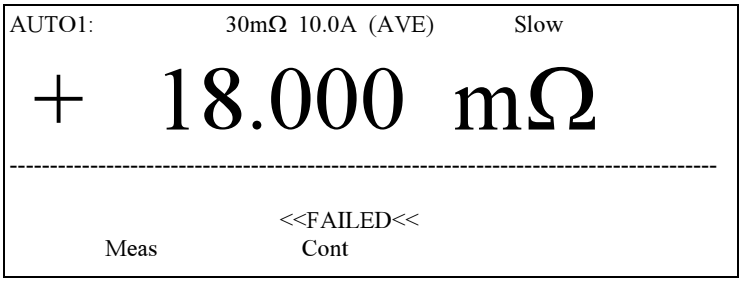
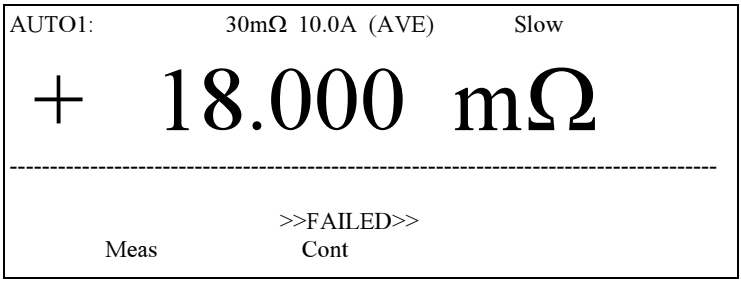


Figure 5.6.2 Measurement display with limits value to high



5.7 Measurement of Inductive Devices

GENERAL
When the Settling algorithm is selected, and the 'MEAS' button pressed, continuous measurements will be made until two consecutive results are within the selected limit, or until the selected maximum number of measurements has been reached. In the first case, the final result will be displayed, and in the second case, the message: "MEASURMENT ERROR – Failed to Settle" will be displayed. If appropriate, the result (or the 'error value') will also be datalogged, sent out on the bus, and sent to the Analogue Output on the PLC card. Finally, if the Measurement Limits facility is selected, then the PASS/FAIL result will be displayed.

The Settling facility can be used in 'SLOW' mode only.

Normally, the Settling facility should be used in 'SINGLE' trigger mode, and the above description assumes this. However, if 'CONTINUOUS' trigger mode is used, then the operation is the same, except that once the measurement has settled, the settling facility is effectively disabled, and the DO5000 continues to take measurements without interrupting the current, until 'STOP' is pressed. When 'MEAS' is pressed again, the Settling facility will be re-engaged.

MENU ACCESS
The menu is accessed by pressing 'MODE', followed by 'Sett'. From this point, the following parameters can be set:

On/Off:	Selects/Deselects the Settling Algorithm
No. Rdgs:	Selects the maximum number of readings to be taken (2 – 999). This will give a maximum measurement time of approximately 8 minutes.
Limit:	Selects the maximum number of display digits by which the two consecutive readings may differ, for the measurement to be defined as 'settled' (1 – 999).

When the facility is selected, the word 'Sett:xxx' will appear in the top right corner of the screen. 'xxx' shows the maximum number of readings to be taken, but during a measurement, it counts the number of readings taken when the measurement settled. ('Sett:' will flash during measurement.)
Note that if 'CONTINUOUS' trigger mode is used, then the counter will freeze at the number when the measurement settled, even though measurements will continue.

EFFECT ON OTHER PARAMETERS
- Selecting the Settling facility will:
- Cause the Autorange to change range in a downward direction only. (Therefore, only 'Auto1' autorange mode should normally be used.)
- Deselect the Filter facility.
- Change Average current mode to Positive current mode.
- Cause an error message if in Fast mode.

PARAMETERS WHICH WILL DESELECT THE SETTLING FACILITY
- The Settling facility will be deselected if:
- Filter facility is selected.
- Average current mode is selected.
- Fast mode is selected.

REMOTE COMMANDS
See attached extract from the Remote Interface Manual for details, and an example programme.

OTHER ISSUES

Due to inductive effects, ‘Overange Error’, ‘Polarity Error’, ‘Excess Resistance in Current Leads Error’ and ‘Open Circuit Error’ will all be ignored until the final measurement.

If the Autorange changes the range during a measurement, then the ‘Number of Readings’ counter will reset to one.

If the measurement does not settle within the maximum number of readings, then the ‘Resistance’ bit (Bit 9) of the Questionable Data Condition/Event Registers will be set.

When in Manual mode, a short beep will be heard when the measurement is completed, or a longer beep if the measurement failed to settle.

6 Accessories

6.1 Leads

The DO5000 may be used with a variety of lead sets. The following are the available selection. Remember, if you do not see suitable leads for your application, please consult our customer help desk.

Ordering Code	Description
HS01-P	Duplex Handspikes with 2.5 metre lead length, current and potential spikes suitable for plate or Bussbar measurements.
HS02-P	Duplex Handspikes as a HS01-P but with 2.5 and 15 metre lead lengths
LS03-P	Large Kelvin clips with 3 metre lead length suitable for attaching to rods bars or cables up to 38mm diameter
LS04-P	As LS03-P but with lead lengths 3 and 15 metres
LS05	Executive lead set consisting of 4 x 1 metre leads with banana plugs, 4 x crocodile clips 4 x test prods and 4 x Kelvin clips (KC1) jaw opening 4mm
LS06-P	Kelvin lead set comprising of miniature Kelvin clips (KC2) with 1 meter leads attached terminated with banana plugs Jaw opening 6mm. Suitable for fine wires.

6.2 Wire Clamps

For the precise measurement of 1 meter cable samples we offer 2 wire clamp options.

Ordering Code	Description
C02	1 metre wire clamp with metal base and provision for temperature sensor suitable for wire cross section 1 to 100mm^2
C02a	1 metre wire clamp with metal base and provision for temperature sensor suitable for wire cross section 0 to 1000mm^2
CO3	1 metre wire clamp with water bath for the precise measurement of 1 meter cable samples 1 to 1000mm

6.3 Coin Jig

For the measurement of bi-metal coins to ensure the resistance of the two metals is within pre defined limits.

Ordering Code	Description
CJ01	COIN JIG will accept all bi-Metal Coins

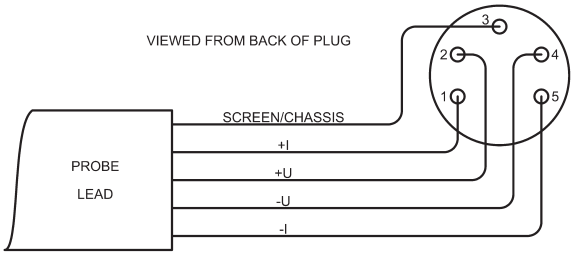
6.4 Interfaces for the Remote Control of DO5000

Ordering Code	Description
DO5000-GPIB	Talk/Listen IEEE-488 Interface
DO5000-PLC	PLC Interface includes Analogue Output and Potential free Contacts for Hi/Lo limits

6.5 Temperature Probe

For the sensing of the temperature of the sample under test.

Ordering Code	Description
5000-Pt100	Pt100 Temperature Sensor Probe length 200mm, diameter 6mm. Fitted with 1 Metre Lead and DIN Plug



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